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Keywords: Yields, Agriculture, Grain, Convergence
JEL Classification: N33, N34, N53, N54

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Provincial grain yields in Spain, 1750–2009[1]

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Abstract

This paper estimates the yields for five grains in 33 provinces of Spain in the mid-18th century. The results show that yields were higher in the north of the country, and that the most fertile provinces of Spain were not far behind the most advanced agricultural regions of the world. Average wheat yields in Spain remained stagnant between 1750 and the late 19th century when they doubled, only to remain stagnant again until the modernisation of the primary sector in the 1960s. Our results show that, in the very long run, yields between provinces tended to converge, and this was the case until the 1960s when the traditional differences in provincial yields began to disappear. The use of artificial fertilisers or new wheat strains were key improvements that helped low yield provinces to break with severe natural constraints such as lack of rainfall or low-quality soils.

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Introduction

On the doorstep of the industrial revolution, grain yields in England had grown to unprecedented levels.[2] The long-term changes that took place in rural England during the 17th and 18th centuries have been considered by many as one of the cornerstones in the development of the English economy.[3] This was not the case for Spanish agriculture and, in fact, in the Iberian case, low productivity levels in agriculture have traditionally been considered as one of the main reasons behind the lack of economic development.[4] When Spain started its industrial revolution the agrarian sector was still unable to feed her own population (De Vries 1990: 62). The situation did not change dramatically during the following 200 years, until the 20th century when Spain carried out substantial changes in farming techniques (Simpson 1995). Therefore, the view that the most recent literature provides of Spanish agriculture is the existence of an economy that, in terms of productivity, was not able to break its natural limitations until the middle of the 20th century.

However, although not a revolutionary change, there is a general consensus around the idea that Spain was able to increase its agrarian production during the 19th century. This increase was, according to Sanchez-Albornoz (1982), based on extensive growth, a consequence of cultivating more marginal lands. Given the nature of the land in Spain, he concludes that productivity did not increase and that, in fact, it probably fell (Sanchez-Albornoz, 1977). In a similar vein, Nadal and Sudria argued that the lack of investments implied that productivity almost did not grow and that the agrarian structure practically did not change during the 19th century (Nadal and Sudria 1993). Simpson argued that productivity in agriculture stagnated until the second half of the 20th century (Simpson 1989). Pinilla considers that institutions played a negative role in the development of Spanish agriculture during the 19th century (Pinilla 2004). Prados de la Escosura, on the other hand, is part of a more optimistic view and argued that, during the 19th century, agrarian output grew more than population and, similarly, Garrabou and Sanz estimated that productivity between 1800 and 1925 increased (Garrabou and Sanz 1985, Prados de la Escosura 1988). Recent studies suggest that productivity in the Spanish agrarian sector increased slightly during the first half of the 19th century, and later accelerated during the first three decades of the 20th century.[5]

Grains were by far the most important crop in Spanish agriculture. It was estimated that, in Castile, often more that 80 per cent of the land was dedicated to the cultivation of cereals (Llopis 2002: 128). Wheat yields in Spain almost doubled during the second half of the 19th

[2] See Allen (1988) Clark (1991) and more recently Broadberry et al (2010).

[3] Allen (2004) and others such as Diamond (1997) Bustelo (1994) and Schultz (1968) have also pointed to productivity in agriculture as a key factor. In a recent paper, Desmet and Parente argued that a reduction of 8 per cent in agricultural productivity would delay the start of the industrial revolution by 225 years (Desmet and Parente 2010).

[4] This argument was used repeatedly in the literature by authors such as Nadal (1984), while others like Fraile argued that low agricultural productivity was not the major cause behind Spanish underdevelopment (Fraile 1991).

[5] Bringas (2000) and Clar and Pinilla (2008). Alvarez-Nogal and Prados de la Escosura argued that the growth of agrarian output per capita was negligible between 1750 and 1850 (Alvarez-Nogal and Prados de la Escosura, 2007, forthcoming).

century, increasing from around 5 Quintals per Hectare (Quintals/Ha) in the mid-19th century to nearly 10 in the first decade of the 20th century Tortella (2003).[6] Yields then remained stable until the modernisation of the Spanish economy which began in the 1960s.[7] However, the study and use of national averages can hide the existence of important regional patterns. Did grain yields follow the same trends in all regions of Spain, or do they present any significant disparities? The current paper will address this fundamental debate by examining the evolution of grain yields in Spain at provincial level from the mid-18th century to the present. The regional dimension of the study will allow us to analyse land productivity in more depth and to give a more precise explanation of its sources. If, as some authors argued, agricultural productivity was crucial for the development of a country like England, its estimation and study in Spain is also essential in order to understand her economic history. The first part of the paper presents the sources and the methodology employed to estimate the grain yields of the 33 provinces of the Crown of Castile during the early 1750s. The Crown of Castile was the main political entity of Spain and represented around 80 per cent of her territory. The second part of the paper introduces the yields of the five main crops that were produced in Spain: wheat, barley, rye, oats and maize, estimated from original archival sources. The results reveal substantial differences that were especially intense between the south-east and the north. We lately compare the results obtained for Spain in the mid-18th century with yields in other countries. We conclude that, although the national Spanish average was below other international standards, yields in the north of the country were not far behind the most productive regions of the world. We later explore the evolution of yields in Spain between 1750 and 2008 at national and provincial level to conclude that it was the 1960s when the provincial differentiation in grain yields began to disappear. We believe that the process can be explained thanks to the modernisation of Spanish agriculture during the second half of the 20th century, which was a major force in the convergence between low and high yield regions.

Sources and methodology

Tithe records have traditionally been the most important source of information for the estimation of grain production. From Old English teotha (tenth), tithes represented a 10 per cent flat tax that was paid every year by producers in the primary sector to the church. All the products were charged, from the main ones such as grain, wool, wine or olive oil to minor products such as cheese, honey or chicken. In Spain the payment of the tithe was compulsory until the "Desamortizacion of Mendizabal" in 1837 when the government confiscated ecclesiastical lands and theoretically released producers from the payment of the tithe. Tithes are therefore an excellent source to estimate the evolution of agrarian production until the early 19th century when their reliability decreased significantly with the economic and social turmoil produced by the Napoleonic wars.[8] However, tithe records only mentioned the amount of product that was paid and did not explain the land that was being used to produce it. Therefore they cannot be used to estimate yields unless we

[6] Although some authors like Simpson (1997) are reluctant to accept the increase.
[7] Instituto Nacional de Estadistica (INE) (1900–1970)
[8] Garcia Sanz (1982) see Anes (1970) for some of the first estimations in Spain and Goy and Ladurie (1982) for a compilation of several works.

assume that the percentages of land put under cultivation remained constant, an assumption that is clearly unreasonable.

For that reason the main source use in this paper is the *Catastro de la Ensenada*, a general survey that took place in Castile in the early 1750s and which contains enough information to estimate grain yields. In the mid-18th century King Ferdinand VI and his government tried to modernise the fiscal system in Castile with the introduction of a general tax. In order to calculate the amount that had to be paid by each municipality, he ordered the elaboration of a survey known as the Catastro de la Ensenada that was answered by all municipalities in Castile. All the municipalities had to create a committee that responded to several questions including social and economic aspects of the place and its inhabitants. The level of information included in the Catastro is so high that it is considered the most detailed survey ever conducted in Spain.

The information was divided between “particular” and “general” answers. Particular answers were the most detailed records and studied the situation of every family in every village. Each family had to present information about its members including ages, names, jobs, incomes, properties, debts or credits, and a long list of further requirements. The general questions were gathered in a similar way to the *Domesday Book*, where the officers visiting every municipality in Castile interviewed a group of representatives. If the information contained in the works of Arthur Young has been extensively used to estimate grain yields in England, Ireland or France, the level of detail achieved in the Catastro provides a monumental dataset for their accurate estimation in Spain. The resources dedicated to the survey matched the ambition of the government that used the work of around 1,000 judges, 6,000 men and 90,000 local experts who measured and studied every single piece of land in more than 14,000 municipalities spending over 40 million reales.

In the paper we use information from the “general” answers that include a list of 40 questions made to the local authorities by the royal officials. We used the answers given to questions 9, 10 and 12 in the survey to estimate grain yields in each location. The answer to question 10 requested information about the amount of land that was used for each main agricultural product, as well as the quality of the soil. The answer to question 12 described the average yield of the grains produced in each type of land depending on its quality.[9] One of the most challenging problems of the source is that the unit of measurement changed drastically depending on the region where the municipality was located. In general, most of the provinces in Castile, especially in the centre and south, used fanegas as a unit of dry volume and unit of area. However, sometimes there were changes in the units even within the same province. For example, in the province of Madrid 1 fanega of land in the village of Getafe contained 3,441 square metres, while in Cenicientos, also located in Madrid, the same fanega contained 5,161 square metres. Even further, also in Madrid the village of Chinchon did not use the fanega but the obrada, a unit that contained 1,404 square metres.[10] To deal with this problem we used the information provided in question nine of the Catastro that describes the different units used in the

[9] The Catastro normally distinguished between three types of land: first quality (the best), second quality (medium) and third quality (the lowest). The output produced by each type of land in the municipality was reported to the national authorities.

[10] The appendix includes examples of the different units used in different provinces and their values in square metres.

village and their corresponding value in Castilian bars.[11] In terms of capacity there was also a wide variety of units that changed depending on the region. In the north, especially in Galicia, the ferrado was used instead of the fanega. As in the case of capacity units, the same unit could have different values in different locations. With the information contained in question nine, we transformed capacity units to Quintals and surface units to hectares (Ha). The standardised yields that we present in this paper for the 33 provinces were therefore calculated in Quintals per hectare.

Figure 1: 33 Provinces in the Crown of Castile (modern boundaries)

To generate the provincial averages we chose a sample of municipalities in each province and calculated the yields for the grains that were cultivated. The provincial yield was calculated as an average of the sample weighted by the amount of land used in each municipality. The methodology is very similar to the impressive work of Bringas who, using the Catastro, reconstructed productivity figures for 14 provinces in Castile Bringas (2000). However, this sort of estimation can lead to misleading results, mainly the consequence of the different uses that could be given to land in each region. Let us assume that, in a specific province, the most fertile land is used to produce fruits and the cultivation of grain is relegated to the worst soils. In that case, the grain yields obtained in that province would be underestimating the potential yields that could be achieved if grain was cultivated in all the types of land as in the rest of the country. We decided to check if this was a relevant factor in our estimations by comparing our averages with the yields obtained in each province using only the best lands defined in the registries as first quality. The results indicate that the provincial differences of both estimations were practically identical, and therefore that our average yields are also a good estimation of the potential yields that could be reaped in each province.[12]

Given the complexity of the administrative boundaries of the provinces in 18th century Spain, we chose the modern limits to aggregate the samples (Figure 1).[13] This exercise will

[11] The Castilian bar was a standardised measurement that contained 0.838 metres.
[12] The correlation between both estimations was 93 per cent.
[13] See map in the appendix with the old provinces and the modern map that is used in the paper.

also allow us to compare the productivities obtained for the 18th century with the values in the 20th and 21st centuries when the geographical boundaries use the modern provinces. The sample that comprises 400 municipalities from 33 provinces is geographically spread within each region, and includes a wide variety of locations from large towns to very small villages.[14] In terms of geographical coverage, the sample of municipalities represents more than 20 per cent of the territory of the 33 provinces.

Provincial yields

Table 1 and Figure 2 present the yields calculated for the five main grains produced in the 33 provinces and show the existence of a clear geographical pattern. The six provinces in the north of Castile lead the ranking with wheat yields over 7 Quintals/Ha, and in the case of Pontevedra even reaching 9.4 Quintals/Ha. On the other hand, the provinces in the south-east obtain the lowest yields in our estimations with Almeria, Ciudad Real and Albacete presenting the lowest values.[15]

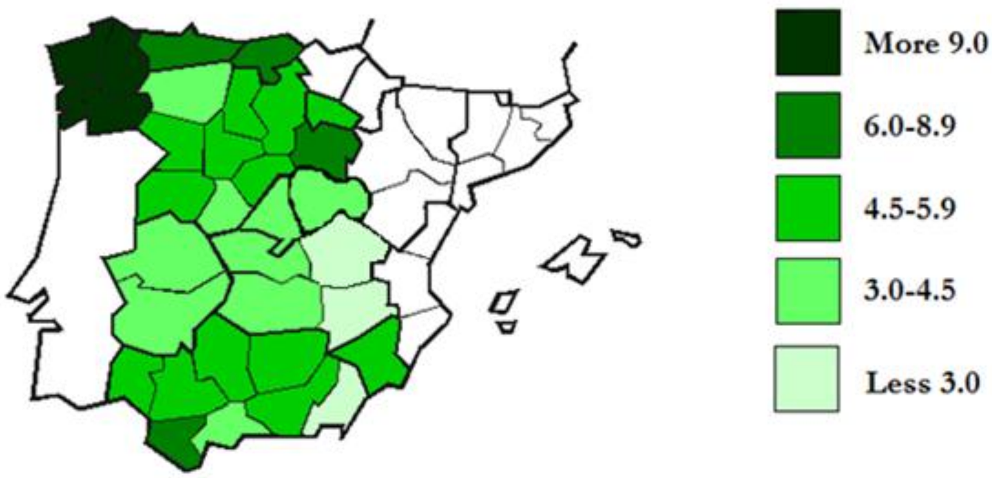
Table 1: Yields in Quintals/Ha, 1750s

	Wheat	Barley	Rye	Oats	Maize		Wheat	Barley	Rye	Oats	Maize
A Coruña	8.7	12.6	6.9	—	9.8	**Leon**	4.4	20.3	3.8	6,9	—
Albacete	2.3	4.1	2.5	2.5	—	**Lugo**	8.9	—	9.8	—	9.5
Almeria	2.7	4.0	3.0	—	5.1	**Madrid**	4.2	9.9	3.6	4,0	—
Asturias	7.5	—	7.9	7.1	10.8	**Malaga**	3.9	5.1	5.5	—	14.9
Avila	4.4	8.9	3.9	—	—	**Murcia**	5.3	9.0	5.0	—	—
Badajoz	4.3	3.7	—	—	—	**Orense**	8.0	—	6.1	—	9.2
Burgos	4.8	6.2	3.5	5.1	—	**Palencia**	5.9	20.0	5.2	6,0	—
Caceres	3.6	4.8	4.0	—	—	**Pontevedra**	9.4	—	7.2	—	8.4
Cadiz	6.3	10.1	—	—	—	**Salamanca**	5.2	15.3	4.1	—	—
Ciudad Real	3.3	7.1	4.4	2.9	—	**Cantabria**	7.3	8.0	6.4	—	—
Cordoba	5.8	7.7	3.8	3.9	—	**Segovia**	5.3	10.7	3.1	5,1	—
Cuenca	1.8	5.9	1.6	2.8	—	**Sevilla**	5.1	7.8	—	—	—
Granada	4.8	4.6	2.8	2.4	3.0	**Soria**	6.3	9.6	4.1	5,6	—
Guadalajara	3.8	7.9	3.7	5.1	—	**Toledo**	3.7	9.5	4.2	5,7	—
Huelva	4.6	6.0	3.8	4.7	3.3	**Valladolid**	5.4	17.6	3.7	4,6	—
Jaen	4.7	7.1	4.8	5.6	—	**Zamora**	5.2	15.3	5.4	—	—
La Rioja	5.2	8.3	5.7	8.1	—						

Source: Own calculations from the Catastro.

[14] See appendix for a detailed description of the sample.
[15] The appendix includes a map with the names of the provinces as well as four maps with the yields of barley, rye, oats and maize.

Figure 2: Wheat Yields in Quintals/Ha, 1750s



Source: Own calculations from the Catastro.

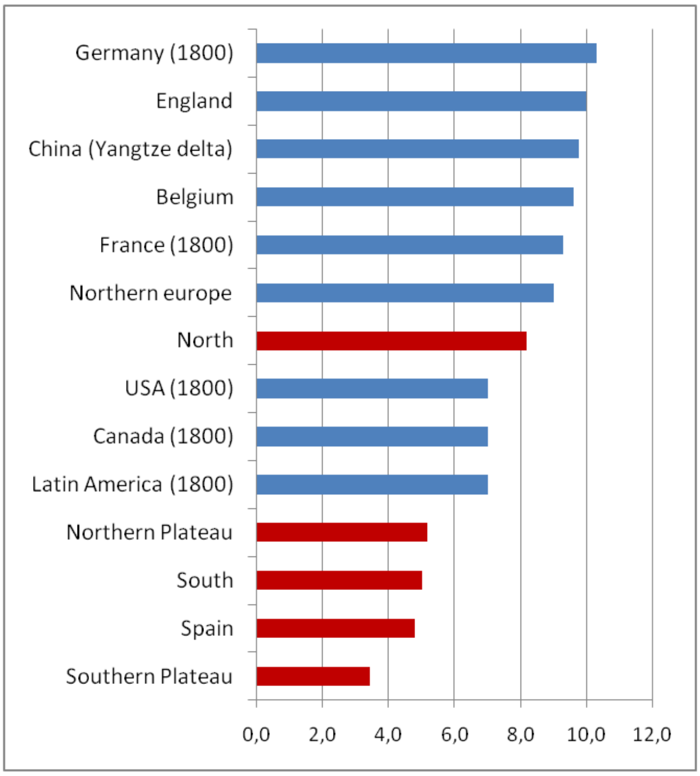
On average, the provinces in the north also present higher yields in the case of the other four grains with few exceptions.[16] Barley was practically not cultivated in coastland provinces in the north, although it was common in the rest of the country with the highest yields reached in the north of Old Castile. The lowest yields are, as in the case of wheat, located in the south-east and also in the province of Badajoz. Rye yields were again highest in the provinces of the north, where they reached the maximum values. Oats and maize were not as spread as wheat, rye or barley. In fact, only the wet weather of the north made possible the cultivation of maize, while it was not a feasible option in the rest of the country. The analysis of both rye and maize indicates that the yields of the two crops show the same behaviour as the other three, with the provinces in the north reaching the maximum values and the south-east with the lowest production per cultivated unit of land. The average productivity estimated for Spain in the early 1750s was 4.8 Quintals/Ha, a value that is similar to the estimation of Bringas for the same time.[17]

But how good or bad are these results in an international comparative perspective? The estimation of wheat yields in England range from 10 Quintals/Ha in the mid-18th century to nearly 15 Quintals/Ha in the early 19th century Clark (1991: 456). The estimations for other European countries show similar results, with Ireland and Holland probably achieving yields close to England in the early 18th century.[18] Germany produced 10 Quintals/Ha in 1800 and the values for northern Europe were close to 9 Quintals/Ha Chorley (1981: 83). Wheat yields in Belgium in 1760 reached on average 9.6 Quintals/Ha Dejongh (1999: 17). The average grain yield in Spain was disappointing and, with 4.8 Quintals/Ha are, according to Allen, similar to the results that Roman farmers were able to obtain. The average yield in Spain was at the end of a "yield ladder" constructed by Hanson, Borlaug and Anderson that is achieved with wheat in dry lands with traditional techniques Allen (1992: 132). However, Allen also suggests that the yields obtained in north-western Europe were exceptional, and that only few exceptions in the rest of the world, such as the Nile basin or the Yangtze

[16] Figures 16–19 in the appendix include the map of the yields for barley, rye, oats and maize.
[17] Bringas estimated a productivity of 4.7 Quintals/Ha in Spain (Bringas 2000).
[18] See Allen and O'Grada (1988: 107) and Allen (1992: 131).

delta, reaped similar results with wheat yields around 9.7 Quintals/Ha Allen (2009). Outside north-western Europe yields were considerably lower, with values around 7 Quintals/Ha in the early 19th century in areas such as India, Latin America, Canada, Australia or the United States (US) Allen (1992: 131). In the mid-18th century rye yields in Russia averaged around 4.0 Quintals/Ha, a value that was surpassed in most of the Spanish provinces Mironov and A'Hearn (2008: 918). Therefore, although the differences between Spain and north-western Europe were substantial, the comparison with the rest of the world is less pessimistic.

Figure 3: Wheat Yields in Quintals/Ha, 1750s[19]



Sources: for Spain own calculations from the Catastro; for England – Clark (1991), Allen (1988) Overton (1979, 1990) and Turner (1982); for France – Allen and O'Grada (1988) and Hoffman (1988); for China – Allen (2009); for Belgium – Dejongh (1999); for USA, Canada and Latin America – Allen (1992); and for Germany and Northern Europe – Chorley (1982).

We should also take into account the substantial regional differences in the results obtained for Spain. The national average is clearly disappointing, but the yields in the northern regions were not so far behind the most advanced agrarian regions in the world. The six provinces in the north of Castile averaged 8.4 Quintals/Ha, and the province of Pontevedra 9.4 Quintals/Ha. Regional differences were also substantial in other countries like France, where wheat yields ranged between 5.2 Quintals/Ha and 14.6 Quintals/Ha Allen and O'Grada (1988: 111). Regional variability was also high in Belgium where, in 1760, wheat yields ranged from 5.5 Quintals/Ha in Luxembourg to 11.6 Quintals/Ha in Hainault Dejongh (1999: 17). Therefore if we take into account the yields reaped in the most

[19] A map with the divisions can be consulted in Figure 14.

productive provinces of northern Castile, the results indicate that the differences with some of the most efficient grain producers were not so overwhelming.

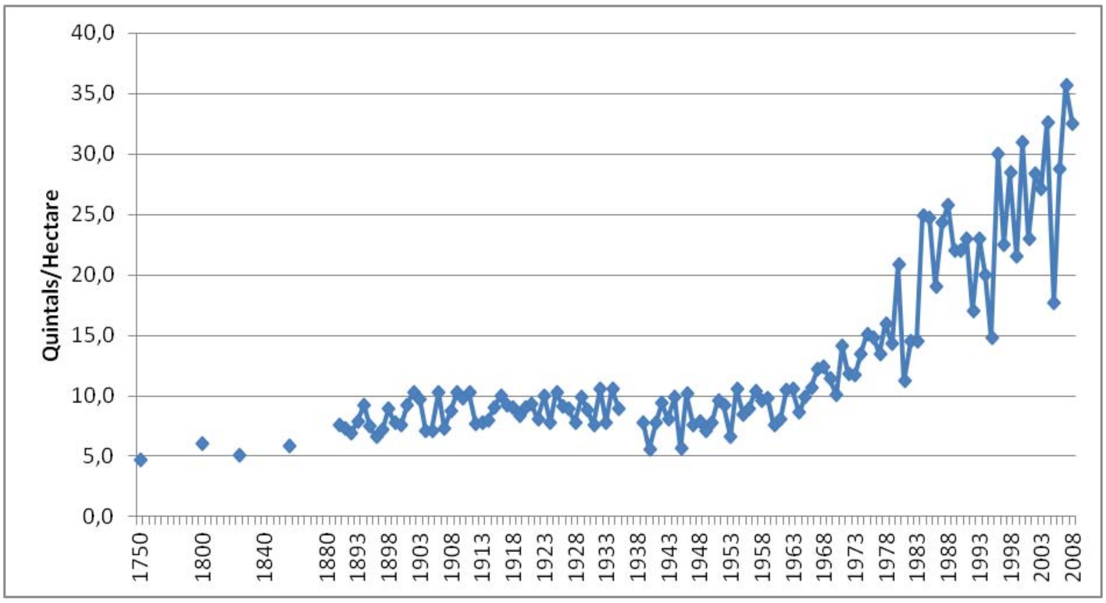
Geography and climate played an important role in the disadvantage faced by Spain. While in countries like England or France a high proportion of the soil has high or very high suitability for the production of rain-fed wheat, in the case of Spain the terrain ranges from simply not suitable to marginally or moderately appropriate.[20] However, an important problem faced by producers in the north of Castile was the marginality of the terrain. The irregular landscape and the high percentage of marginal lands reduced the amount of soil that could be used in the production of grain. The inhabitants of the north commonly complained about this situation: in the village of Amoedo in Galicia in the early 1750s they explained that "in this parish we do not cultivate wheat because the land is rough and hilly".[21] We examined the proportion that the land used for grain production represented as percentage of the total and, while in the provinces of Galicia the percentage reached 20 per cent, in the rest of Castile values around 40 per cent and even higher were common.[22] Therefore in those areas where the climatic conditions were as good as in north-western Europe, the quality of the terrain only allowed a small percentage of the land to be cultivated. The terrain in the south of Castile was more favourable than in the north, with a lower percentage of wastelands and forests. Land was also more concentrated in the hands of fewer producers that owned huge *latifundia*. Therefore in principle the south of Spain was more suitable for the emergence of economies of scale like the concentration of properties that took place in 18th-century England. However, the level of rain in the south was lower than in the regions of the north limiting its productive potential.

The long term evolution of yields, 1750–2008

Figure 4 shows the evolution of wheat yields in Spain between 1750 and 2008, presenting a relative stagnation until the last quarter of the 19th century when yields doubled. The stability between 1750 and the late 19th century shows that 5 Quintals/Ha was probably the pre-modern ceiling that was in part defined by the natural constraints. After the increase of the late 19th century, no improvements took place until the early 1960s, when the agrarian sector was again able to break the productive ceiling and yields increased exponentially.

[20] See Global Agro-ecological Assessment for Agriculture in the 21st Century: Methodology and Results. 2002 International Institute for Applied Systems Analysis.
[21] Responses to question 12 of the village of Amoedo to the Catastro.
[22] Calculations from the books of the Catastro.

Figure 4: Wheat Yields in Spain 1750–2008



Sources: for 1750s – own calculations from the Catastro; for 1800 – Garrabou and Sanz (1985); for 1820 – Bringas (2000); for 1857 and 1890 – Tortella (2003); and for 1900–2008 – INE (1900–2008).

The increase in yields that took place during the last years of the 19th century has generated controversial debates between economic historians. For some authors the increase was real and shows the existence of improvements in production that could be reaped in every hectare GEHR (1983: 303). Others like Simpson are more reluctant to accept the figures as authentic, and believe that they could simply be the consequence of a statistical error, although he also accepts the possibility of a real increase Simpson (1995: 120). Our results indicate that, in any case, an improvement took place between the mid-18th century and the first reliable estimations in the 20th century, although it is not clear to what extent the improvement was as sudden as Figure 4 shows or if it was more a consequence of steady and slow process over 150 years. If we believe that the estimations for the late 19th century were real, then it was between 1890 and 1910 when most of the increase took place. One of the possible explanations of the increase is based on the role played by artificial fertilisers and the extension in the use of better ploughs in the production of dry grains GEHR (1983: 304). Simpson again is sceptical of the role of fertilisers and notes that, in the first years of the 20th century, only 143,000 tons of artificial fertilisers were available for all Spanish farmers, an amount that he considers insufficient to explain the improvements in wheat yields. He also mentions that the use of most of the fertiliser used in grain production was mainly focused on the cultivation of marginal lands that without the nutrients would be unproductive Simpson (1995: 122–3). We should also take into account that different products used different types of artificial fertilisers and that, as Table 2 shows, in the case of grains and legumes phosphates represented the lion's share.

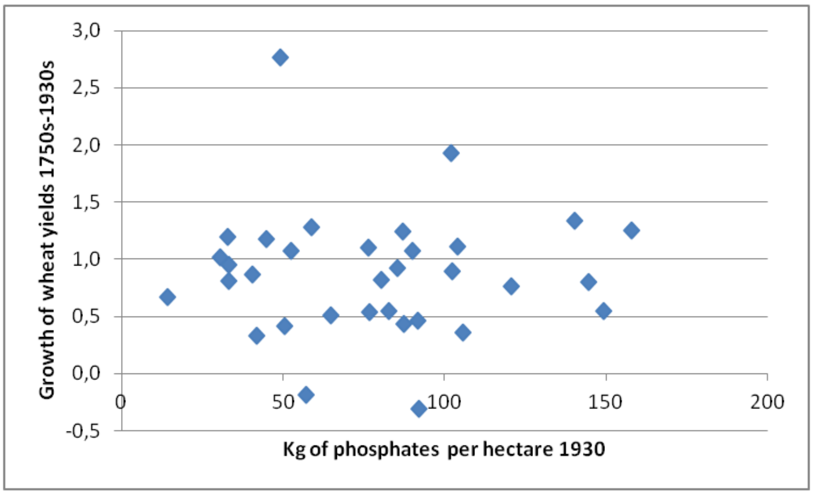
Table 2: Use of Chemical Fertilisers by Crop Type, 1933 (Kg per Hectare)

	Phosphates	Nitrogen	Potassium
Cereals and legumes	60	16	1
Intensive crops	170	121	26
Vines and olives	18	8	1
Artificial pasture	88	5	0

Source: Simpson (1997).

Taking advantage of the provincial dimension of our dataset, we decided to carry out a statistical analysis to see if the regional differences in the use of phosphates could explain the different growth rates of the Spanish provinces. We chose 1750 as our first benchmark and 1930 as the second one. Figure 5 shows the relationship between the growth in yields between 1750 and 1930 and the consumption of phosphates by hectare of arable land in 1930. The results reject the existence of a significant relationship between both variables, suggesting that those provinces that increased yields more rapidly did not do it because they invested more heavily in the use of phosphates.

Figure 5: Growth of Wheat Yields vs. Consumption of Phosphates Per Hectare



Sources: for 1750s – Catastro de la Ensenada; for 1930s – Anuario Estadístico de España. For phosphates per hectare – Anuario de Estadística Agraria.

The reduction in the surface of arable land could be an alternative explanation of the increase of yields of the late 19th century. If there was a significant reduction in the amount of land used to produce grain, then farmers could have focused their efforts in the best ones, abandoning marginal lands and therefore increasing yields. We studied the evolution of arable land used in the production of grain between 1886–90 and 1903–12, the period when we observe the most intense growth in wheat yields.[23] Figure 6 shows the relationship between the changes in cultivated land in that period and the increases in yields between 1750 and 1920. The results show that, as in the case of artificial fertilisers, there is not a significant relationship between the changes in arable land and the growth in yields, suggesting that the former was not an important factor driving up the latter.

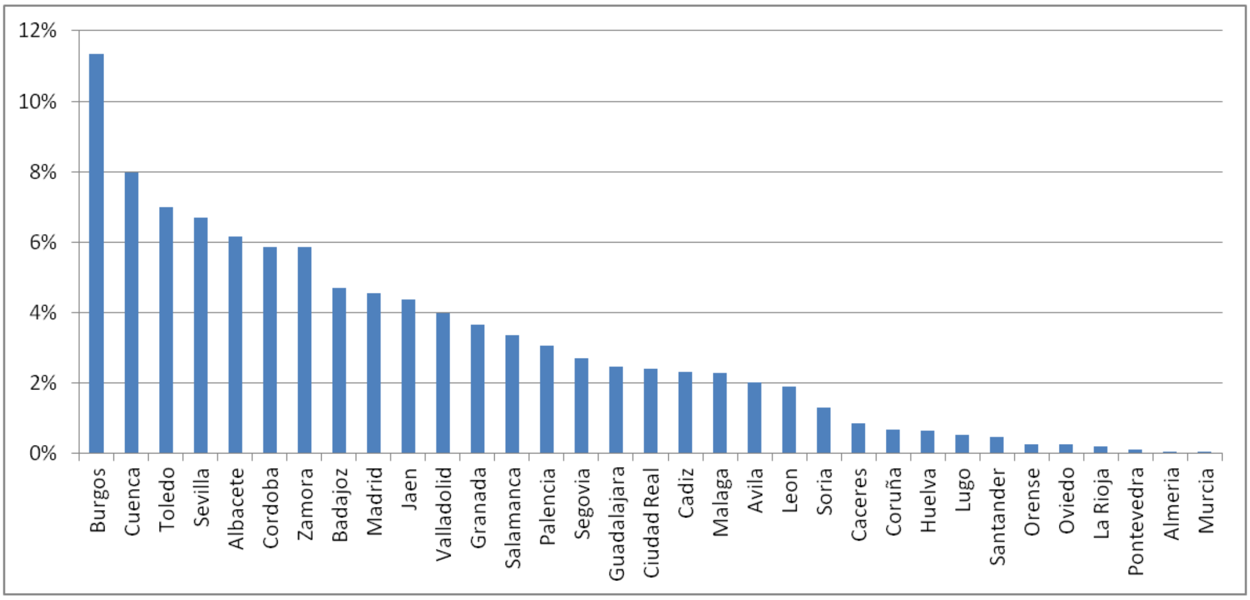
[23] The information of arable land was taken from GEHR (1983).

Figure 6: Growth of Wheat Yields vs. Increase in Arable Land

Sources: for 1750s – Catastro de la Ensenada; for 1930s – Anuario Estadístico de España. For growth of arable land – GEHR (1983).

Therefore neither the use of fertilisers nor the concentration of grain production in the most fertile lands seem to have been significant forces in the changes in grain yields that we observe in the late 19th century. If we decompose the average yield for the country by province, we can identify the areas that contributed more to the increase. Figure 7 shows the contribution of each one of the 33 provinces to the increase in yields between 1750 and 1920. The results show that the increase in yields was mainly an event that took place in the interior of the country, where seven provinces (Burgos, Cuenca, Toledo, Albacete, Cordoba and Zamora) were the responsible for more than half of the improvement.

Figure 7: Contribution of Each Province to the Increase in Yields 1750–1920



Source: own calculations from the Catastro and 1930s Anuario Estadístico de España.

But how high or low were the average yields in Spain compared to the rest of the world in the long run? A comparative analysis with England reveals that the situation in Spain was far from being satisfactory and, even worse, in the last 250 years the relative differences between both countries far from diminish and have remained stable. As previously explained, in the mid-18th century wheat yields in England were double that which could be reaped in Spain. The situation worsened during the following 70 years and, by 1820, the yields in England were four times the yields in Spain. The main reason of this considerable increase was the stagnation in the case of Spain while the yields in England almost doubled. The following hundred years were a period of sustained convergence between England and Spain, and by 1920 the Iberian country had been able to reduce the differences thanks to the relative stability of the English yields. However, the quick and sustained improvements in England produced a new period of divergence and, by 1980, the distance between both countries reached the relative maximum with a ratio close to 4.5. The last 20 years have been a period of convergence when Spain was been able to reduce the differences. If we observe the trend in the very long run, the data show that the relative differences between the English and the Spanish yields have remained stagnant and therefore have shown little improvement.

Figure 8: Wheat Yields in England and Spain 1750–2000

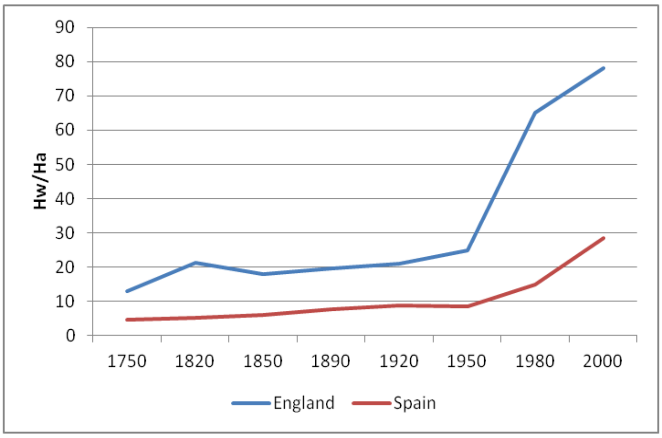
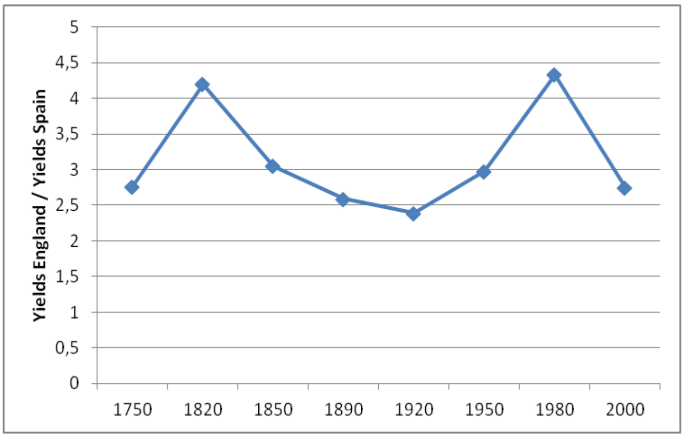


Figure 9: Ratio Yields England/Yields Spain



Source: For Spain – same as Figure 4; for England – Clark (1991), Allen (1988), Overton (1979, 1990), Turner (1982), Collins (2000) and Austin and Arnold (1989).

Although the study of the national averages can reveal important and useful information, the analysis of the regional trends is probably more interesting as it helps us to understand the internal dynamics of the changes. Did the different provinces tend to converge or did the differences that existed in the mid-18th century persist over time? In order to measure the convergence between provincial grain yields, we decided to use two different concepts that have been extensively used in the literature. Beta (β) convergence is defined as a process where those areas with lower starting points catch up, presenting higher growth rates than those areas with higher starting values. One of the ways of checking the existence of β convergence is the use of the so called Barro (1991) regressions that regress the average growth rates and the initial starting point. If the coefficient obtained is negative and statistically significant then we can admit the existence of β convergence. Although the method has been criticised by authors like Friedman (1992) and Quah (1993), we will employ it as it has been extensively used in the literature.[24] However, to improve the study we will also analyse the evolution of the coefficient of variation in our sample (σ convergence), a method that, according to Friedman (1992), provides unbiased estimates of β convergence.[25] We will also provide a third alternative that measures β convergence through the study of the mobility in the rankings of the provinces. We divided the 33 provinces between low, medium and high yields taking into account the yields obtained in the mid-18th century to analyse how the growth rates of each group changed over time. Using this method will allow us to better understand the internal dynamics in the changes of convergence. Tables 3, 4 and 5 show the results for wheat, barley and rye.

Table 3: sigma and beta Convergence in Wheat Yields 1750–2008[26]

	1750–1920	1920–1930	1930–1940	1940–1950	1950–1960
Beta convergence	−1.72**	−0.38	−0.72***	0.06	−0.27
Sigma convergence	0.39–0.37	0.37–0.32	0.32–0.39	0.39–0.32	0.32–0.32

	1960–1970	1970–1980	1980–1990	1990–2000	1750–2000
Beta convergence	−1.05***	0.05	−0.99***	−1.69***	−3.04***
Sigma convergence	0.32–0.30	0.30–0.35	0.35–0.35	0.35–0.25	0.39–0.25

Source: own calculations from the Catastro and 1930s Anuario Estadístico de España.

Table 4: sigma and beta Convergence in Barley Yields 1750–2008

	1750–1920	1920–1930	1930–1940	1940–1950	1950–1960
Beta convergence	−5.23***	−.30	−0.90***	−0.12	−0.35
Sigma convergence	0.50–0.38	0.38–0.34	0.34–0.30	0.30–0.34	0.34–0.34

	1960–1970	1970–1980	1980–1990	1990–2000	1750–2000
Beta convergence	−1.14***	0.01	−1.28***	−1.51*	−5.25***
Sigma convergence	0.34–0.26	0.26–0.29	0.29–0.23	0.23–0.26	0.50–0.26

Source: own calculations from the Catastro and 1930s Anuario Estadístico de España.

Table 5: sigma and beta Convergence in Rye Yields 1750–2008

	1750–1920	1920–1930	1930–1940	1940–1950	1950–1960
Beta convergence	−1.56*	−0.23	−0.70**	−0.54*	−0.65**
Sigma convergence	0.37–0.52	0.52–0.45	0.45–0.44	0.44–0.40	0.40–0.36

	1960–1970	1970–1980	1980–1990	1990–2000	1750–2000
Beta convergence	−1.25***	0.25	−0.88**	−0.30	−4.72**
Sigma convergence	0.36–0.25	0.25–0.39	0.39–0.40	0.40–0.45	0.37–0.45

Source: own calculations from the Catastro and 1930s Anuario Estadístico de España.

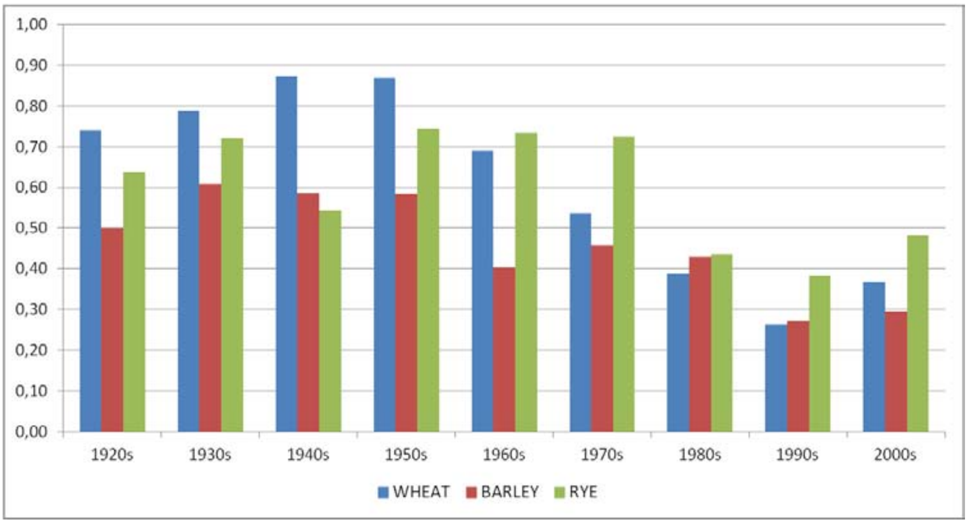
[24] One of the problems of this method is that it suffers from Galton's fallacy, see Quah (1993).
[25] The study of the dispersion or spread of yields also presents methodological problems, as Sala Sala-i-Martin (1995) showed in cases where β convergence could take place in the absence of σ convergence.
[26] The GEHR provides estimations of total production and cultivated area since 1898. However, the reliability of the data during the first years of the sample have been criticised and include inconsistent results like the inexplicable high yields of Almeria around 1916 that would not again be reached until the 1980s. σ convergence is measured as the changes in the coefficient of variation within the sample and β convergence as the coefficient obtained from regressing growth rates and the log of initial yields.

The results show a clear process of convergence in the long run between the mid-18th and the early 21st century, although the paths are not the same for the three grains. Overall, wheat and barley tended to follow the same trends with a strong beta and sigma convergence between 1750 and 2000. If we divide the period into smaller units of time, we observe a clear convergence between 1750 and 1920 that resumed in the second half of the 20th century with an intense period of convergence during the 1960s and the last decades of the century. On the other hand, in the case of rye we observe beta convergence between 1750 and 2000, although the coefficient of variation during the same period increased showing sigma divergence. The same situation is observed during the first period: between 1750 and 1920 the differences in terms of dispersion between the 33 provinces increased, although those with lower starting points tended to grow more rapidly. It was between 1930 and 1970 when most of the convergence between provinces took place while, during the last two decades of the 20th century, the differences increased.

We decided to check to what extend the inter-provincial differences in yields that existed in pre-industrial times remained, and when the influence of modernising forces were strong enough to break with the traditional regional differentiation. Figure 10 shows the correlation coefficient of the yields in the 33 provinces by decade between 1920 and 2000 with the yields reaped in the mid-18th century. Therefore a high correlation coefficient between the yields in 1750 and any given decade would mean that the ranking and the differences in yields between the 33 provinces remained stable between both dates. The results for the two main grains (wheat and barley) indicate that it was not until the 1960s when the structure of leaders and followers started to change its traditional form. Even more striking, around 1950 the structures were more similar to the mid-18th century than the 1920s. This fact could be related to the period of autarky in Spain that followed the end of the Second World War, and the policies that the regime adopted to become self-sufficient in the production of food.[27] The situation changed substantially through the 1950s and, by 1990, the correlations that marked the existence of a traditional regime had practically disappeared. The case of rye as an inferior grain was different, with the correlations with the yields of the mid-18th century remaining high until the 1970s when the modernisation process appear to have a clear impact in the provincial differences. This situation is expected if we take into account that the investments that changed the traditional structure probably took place before in more profitable grains such as barley and especially wheat.

[27] Prados explained the increase of the share of the primary sector in the Spanish economy during this period. Prados (2008: 304).

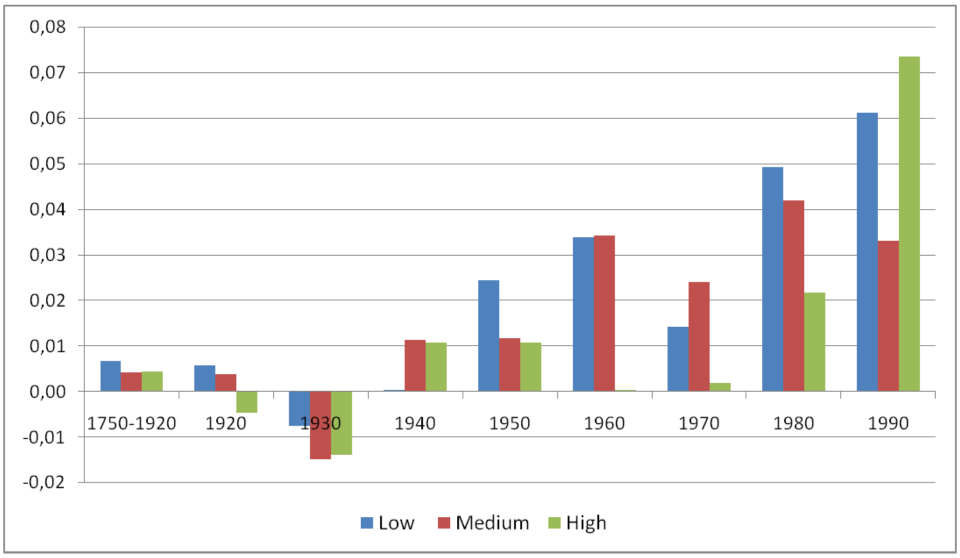
Figure 10: Correlation Coefficient between the 33 Provinces with the 1750s Yields



Source: 1750s own calculations from the Catastro and INE (1920–2008) for the rest.

But what were the forces behind the changes and the continuities? Figure 11 shows the yearly growth rates of yields of the provinces grouped by their yields in the 1750s. During the first period between the 1750s and the 1920s, regions like Albacete or Madrid with initial low yields caught up and, by 1920s, reduced differences with the leaders. The most productive regions of the north and south-west that started the period with already high yields grew on average less than the rest of the country, reducing the disparities. The four provinces of the south east with the lowest yields in 1750 increased them by more than 220 per cent by 1920 while the provinces in the north increased them by slightly less than 170 per cent during the same period of time. The trend continued during the rest of the century with the only exception of the 1940s when low yield provinces grew at lower rates than the provinces in the north and the 1990s when the latter experienced the highest growth rates of the century.

Figure 11: Yearly Growth Rates in Wheat Yields 1750–2008

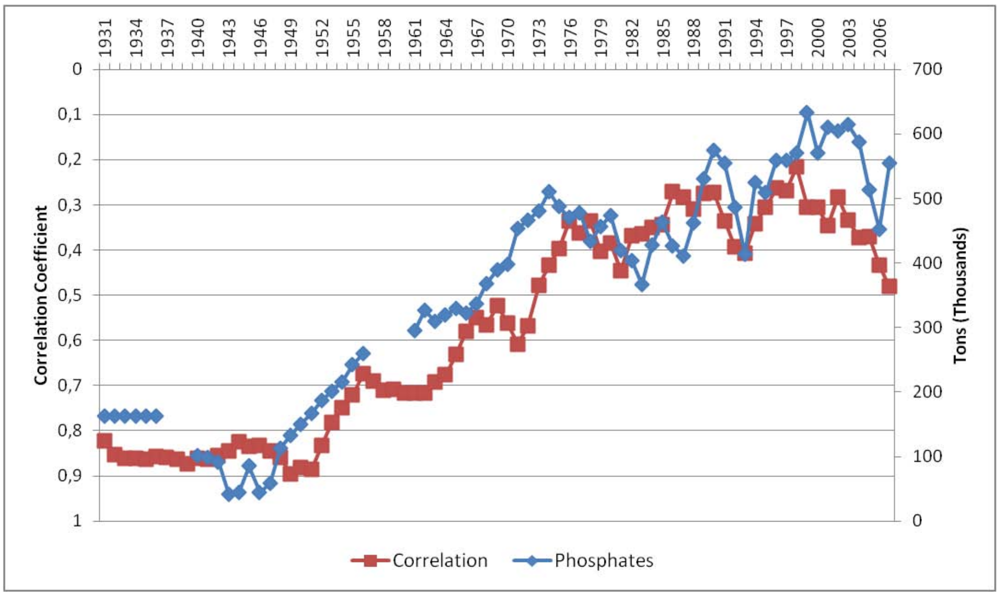


Sources: For 1750s own calculations from the Catastro and for 1920s–2000s INE (1921–2008).

Although the convergence between 1750 and 1920 was clear, during the first 170 years up until the 1920s, the six provinces in the north maintained the highest yields with the four in the region of Galicia again in the top of the list. On the other hand, Almeria in the opposite corner of Castile was again the province that presented the lowest yields. There were some minor changes, however: Albacete, which in the mid-18th century was at the bottom of the list, improved its productivity above the average and advanced five positions. The provinces that traditionally presented lower yields were also those that suffered from lower levels of rainfall or land quality. One of the possible ways in which Spanish producers could have overcome these handicaps was the introduction of alternative sources of nutrients like fertilisers. The access to manure and organic fertilisers was limited again to those regions in the north that enjoyed enough levels of rainfall to feed a sufficient amount of livestock. On the other hand, the use of artificial fertilisers in Spain was not used in the production of grains until well into the 20th century, being mainly focused in the production of intensive products such as fruits and cash crops. Simpson noted that the use of artificial fertilisers in dry lands producing grain was delayed, a fact that explains why the catching up was relatively low until the 1920s but it accelerated during the rest of the century Simpson (1997: 117). As explained earlier, phosphates were the main artificial fertiliser used in grain production, and its utilisation became more profitable from the 1920s, coinciding with the strongest period of convergence between low and high yield provinces. Simpson argued that it was after 1920 when the relative prices between wheat and phosphates made the use of the latter more attractive and therefore their use in grain producing areas more common Simpson (1997: 119).

As we did with the period 1750–1930, we can check if the connection between the use of artificial fertilisers and the improvement of the provinces with traditionally low yields is significant for the rest of the 20th century. As with Figure 10 before, Figure 12 shows the correlation coefficient of wheat yields in the 33 provinces and those reaped in the 1750s, although in this case on a yearly basis. The second variable presented in the figure shows the evolution of the total consumption of phosphates in Spain. We can observe that high correlations in yields (indicating the permanence of the traditional structure of provinces by yields) remained in Spain as long as the consumption of phosphates remained low. However, when the consumption of phosphates started to increase significantly in the 1950s, the correlation began a steady reduction that followed the same trend as the consumption of the fertiliser. Therefore we believe that the mass consumption of phosphates that began to take place in the 1950s was indeed a significant force overcoming the traditional handicaps that low yield provinces had to face.

Figure 12: Provincial Correlation with the 1750s Yields and Total Consumption of Phosphates



Source: Anuarios de Estadistica Agraria (1931–2008) and Anuario Estadistico de España (1931–2008).

Together with the introduction of artificial fertilisers, the Spanish agrarian system carried out a modernisation process that included the introduction of tractors and harvesters. Another important improvement more related to the scarcity of natural resources was the irrigation of certain areas for the production of cash crops. However, these changes almost did not affect the evolution of grain yields until the end of the civil war. It was only after the 1960s when grain yields grew again in Spain, in part a consequence of the introduction of improved wheat strains that also responded better to the use of artificial fertilisers Simpson (1997: 252). The technological improvements coincide with the results presented in Figure 10. The ranking was relatively stable until the early 1960s when the process of modernisation started in Spanish agriculture.

Conclusions

In our study we add a new contribution to the existing literature on agricultural productivity with the creation of a dataset of grain yields in mid-18th century Spain at the provincial and municipal level. Our results for mid-18th century Spain show a clear geographical pattern, with the provinces in the north obtaining yields three times higher than the average grain yields in the south-east of the country. At first sight, the study of grain yields in mid-18th century Spain and the comparison with north-western Europe reveal the existence of an agricultural system that fell behind the most advanced countries in the continent. However, Spanish yields were not so far behind the yields achieved in southern Europe or other parts of the world. In fact, the provinces in the north west of Spain were able to reap yields close to those obtained in some of the most advanced agrarian regions in the world.

On average grain yields remained relatively stagnant between the 1750s and the last quarter of the 19th century, when the first substantial increase took place with yields doubling. However, the improvement did not continue and yields remained stagnant until the 1960s when, as a consequence of the modernisation of Spanish agriculture, yields increased at almost exponential rates. Although in absolute terms yields improved in the long run, the comparative analysis with England shows that the relative differences between 1750 and 2008 remained at similar levels. A regional analysis shows that the improvements were not equally distributed among the different provinces and, although in general low yield provinces outperformed the rest of the sample until 1930 and from 1980, we also observe periods of divergence like the 1970s when they fell behind mid-yield provinces.

The relative differences in yields estimated in the mid-18th century did not disappear until the 1960s. The modernisation of the Spanish agrarian sector was the key for the success of the low-yield provinces, who took advantage of new techniques like the introduction of improved wheat strains that responded better to artificial fertilisers. Together with the new varieties of grains, the intensive use of artificial fertilisers seems to be closely connected with the end of the traditional structure of leaders and followers that had remained stable in Spain for more than two centuries between 1750 and 1950. Paraphrasing Simpson, it was in the 1950s when Spanish agriculture finally woke up from her long siesta. The transformation of the primary sector in Spain during the second half of the 20th century was so intense that did not just break the productivity ceilings, but also the inter-provincial differences in yields that had been stable for more than 200 years.

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Appendix

Methodological note:

In order to calculate the average wheat yields for Spain, we interpolated the results from the average yield for Castile. The average for Castile was calculated by weighting the provincial yields by the proportion of lands that were used in each one to produce grain. The earliest available information at provincial levels is contained in the 1858 statistical bulletin. We extrapolated the Castilian value to a national level using calibrations based on the results presented by the national statistics. Our results show that the coefficient to calculate the average for Spain from the yield in Castile is 0.99, a value that we applied obtaining an average wheat yield for Spain of 4.8.

Units of measurements used in the paper:

Surface

- Dia de Bueyes: used in the north of Spain, especially in Asturias.
- Ferrado: used in the north of Spain, especially in Galicia.
- Fanega: the most common measurement used in Castile.
- Obrada: in some areas equivalent to the fanega, although it changes in other places.
- Estadal: the value changed depending on the region, although it was normally around 16 square varas.
- Carro de tierra o heredad: mostly used in Cantabria.
- Fanega de puño: found mainly in the provinces of the interior. However, it was highly irregular as it was measured as the amount of land that was occupied after seeding one fanega (capacity) of grain.

Length

- Vara Castellana: 0.838 meters.
- Paso: 1 vara castellana.
- Pie: 3 pies made 1 vara castellana.
- Palmo: 4 palmos made 1 vara castellana.

Dry Volume

- Fanega: 55.5 litres.
- Ferrado: normally used in the north. The value depended on the region.
- Maxal: found in Granada had 3 celemines
- Celemin: 12 celemines = 1 fanega.
- Cahiz: 1 Cahiz = 12 fanegas.
- Almud: 2 almudes = 1 fanega.
- Carga: normally 4 fanegas.
- Cuartal: in some areas of the north equivalent to the ferrado.
- Tega: found in areas like Zamora. Normally 3 celemines.
- Hemina: 1 fanega = 3 heminas

Figure 13: Division of provinces by main region

Figure 14: Map with the 19th century provincial boundaries

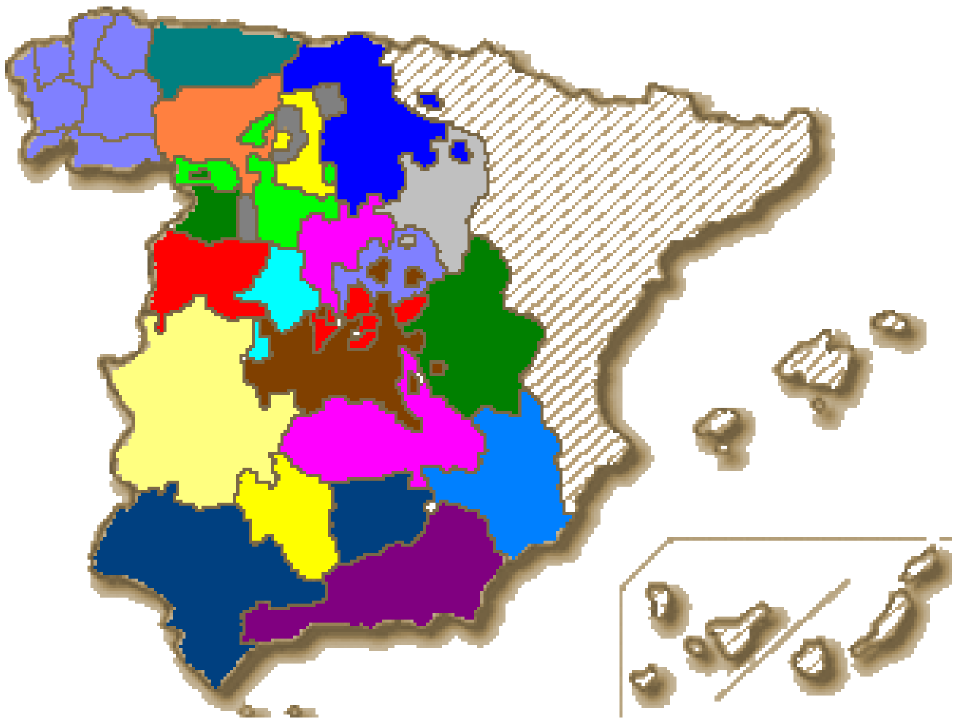
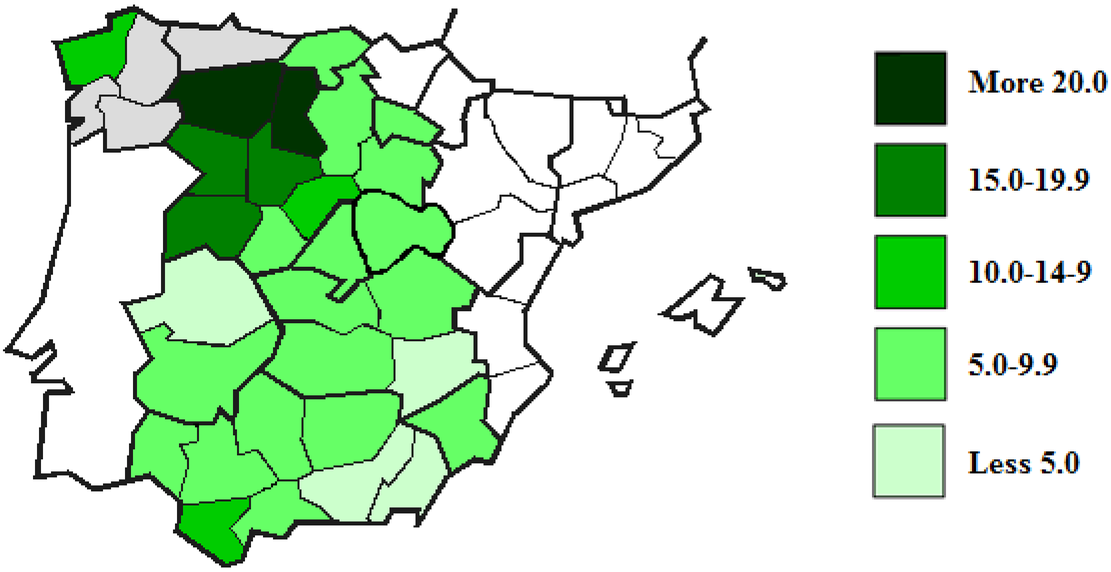


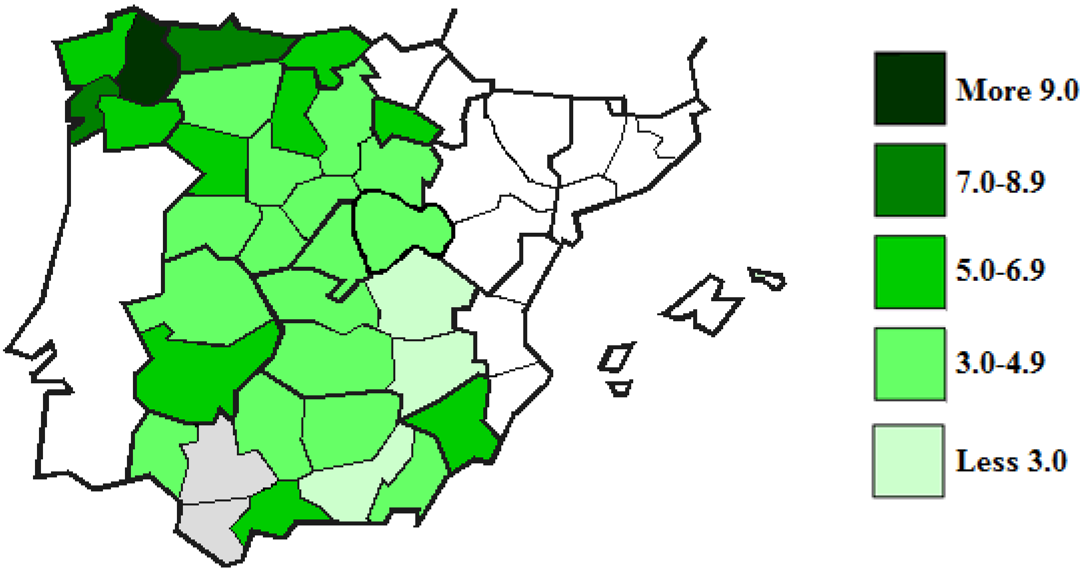
Figure 15: Map with the modern provincial boundaries

Figure 16: Barley Yields in Quintals/Ha, 1750s



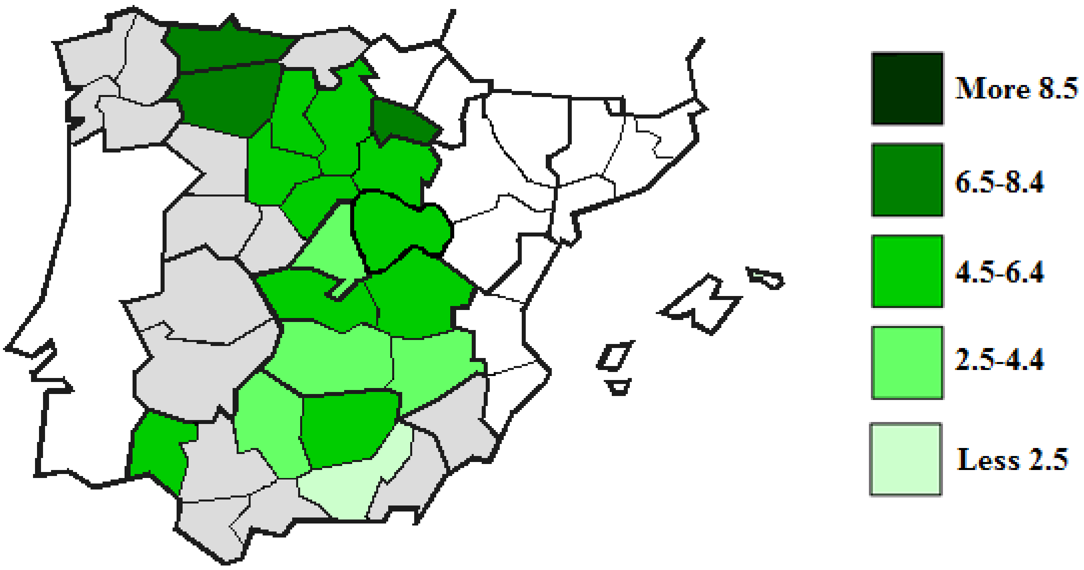
Source: Own calculations from the Catastro.

Figure 17: Rye Yields in Quintals/Ha, 1750s



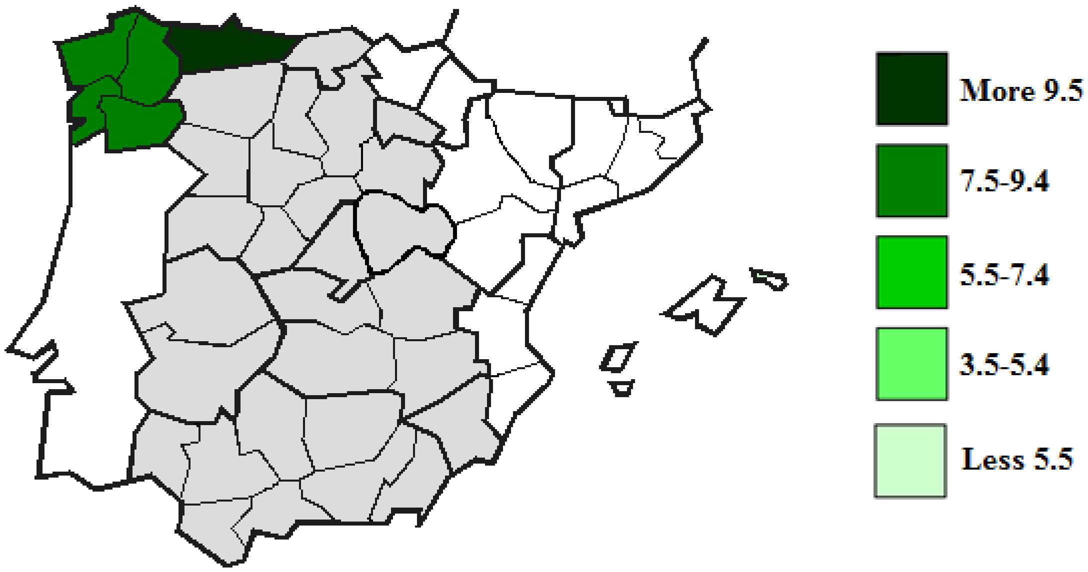
Source: Own calculations from the Catastro.

Figure 18: Oats Yields in Quintals/Ha, 1750s



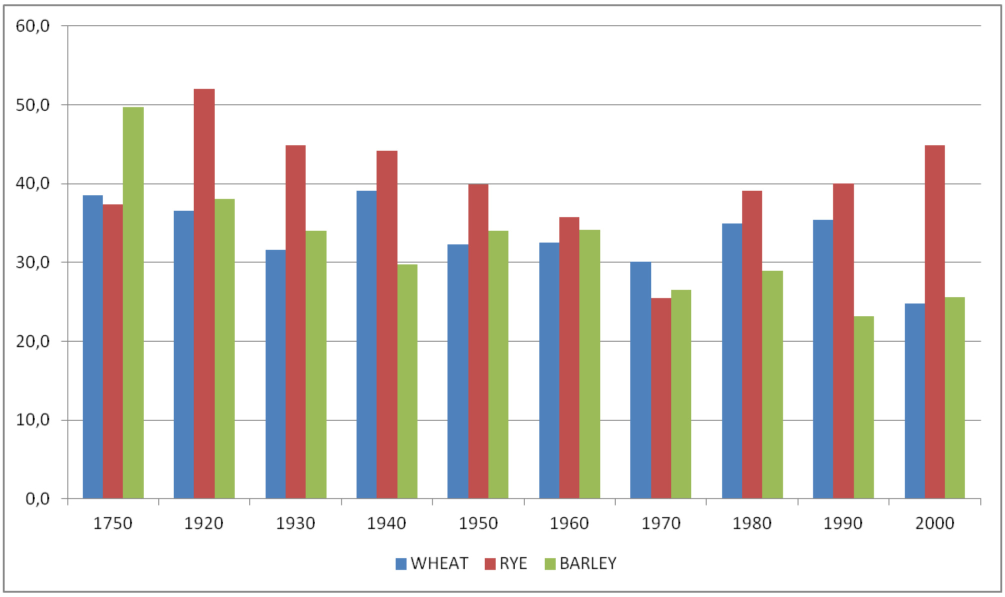
Source: Own calculations from the Catastro.

Figure 19: Maize Yields in Quintals/Ha, 1750s



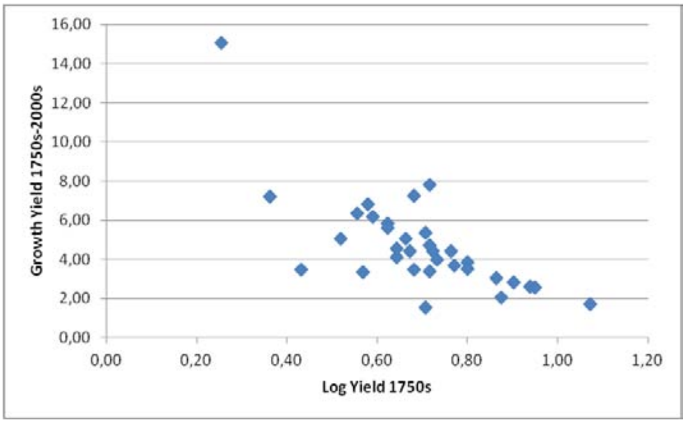
Source: Own calculations from the Catastro.

Figure 20: Sigma Convergence 1750s-2000s



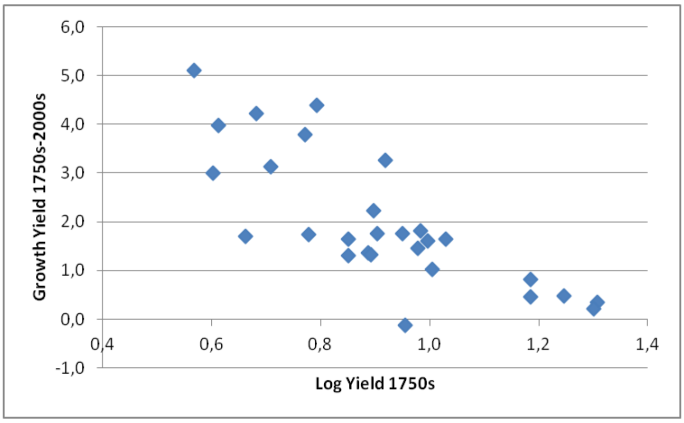
Sources: For 1750s own calculations from the Catastro and for 1920s-2000s INE (1921-2008)

Figure 21: Beta Convergence in wheat yields 1750s-2000s



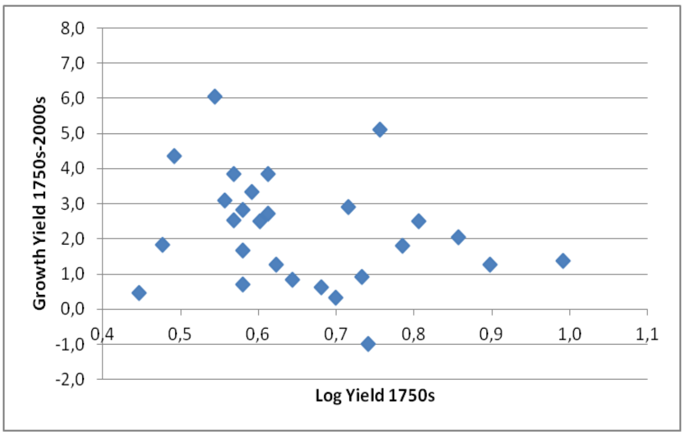
Sources: For 1750s own calculations from the Catastro and for 2000s INE (2000-2008)

Figure 22: Beta Convergence in barley yields 1750s-2000s



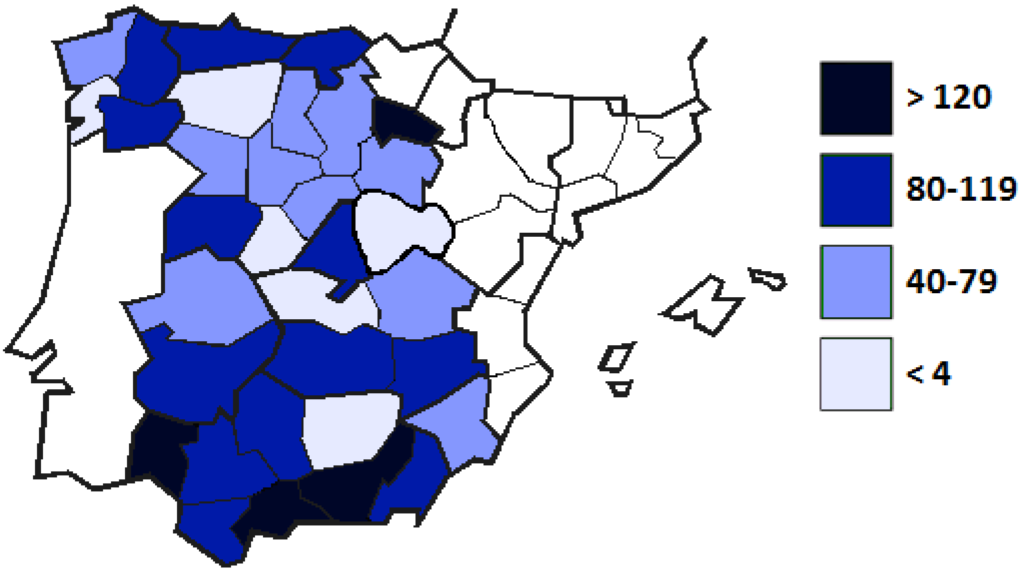
Sources: For 1750s own calculations from the Catastro and for 2000s INE (2000-2008)

Figure 23: Beta Convergence in rye yields 1750s-2000s



Sources: For 1750s own calculations from the Catastro and for 2000s INE (2000-2008)

Figure 24: Consumption of phosphates by hectare of land used to produce grains in 1930 (Kg/Ha)



Sources: Anuario de Estadística Agraria 1930-1931.

Municipalities included in the study of grain yields

Municipality	Province		Municipality	Province
Albacete	Albacete		Castuera	Badajoz
Alborea	Albacete		Don Benito	Badajoz
Alcaraz	Albacete		Helechosa	Badajoz
Almansa	Albacete		Hornachos	Badajoz
Hellin	Albacete		Jerez de los Caballeros	Badajoz
Nerpio	Albacete		Merida	Badajoz
Villarrobledo	Albacete		Monesterio	Badajoz
Abrucena	Almeria		Montijo	Badajoz
Albanchez	Almeria		Valdecaballeros	Badajoz
Albox	Almeria		Villanueva de la Serena	Badajoz
Dalias	Almeria		Aranda de Duero	Burgos
Huercal Overa	Almeria		Barbadillo de Herreros	Burgos
Nijar	Almeria		Burgos	Burgos
Sorbas	Almeria		Castrojeriz	Burgos
Velez Blanco	Almeria		Hontoria	Burgos
Cabrales	Asturias		Ibeas de Juarros	Burgos
Cangas de Narcea	Asturias		Lerma	Burgos
Castropol	Asturias		Medina del Pomar	Burgos
Gozon	Asturias		Rublacedo de Abajo	Burgos
Grado	Asturias		Tortoles de Esqueva	Burgos
Lena	Asturias		Villarcayo	Burgos
Oviedo	Asturias		Alia	Caceres
Piloña	Asturias		Caceres	Caceres
Pravi	Asturias		Cilleros	Caceres
Taramundi	Asturias		Jaraicejo	Caceres
Villaviciosa	Asturias		Malpartida de Plasencia	Caceres
Avila	Avila		Miajadas	Caceres
Cabezas del Vilar	Avila		Talayuela	Caceres
Candeleda	Avila		Zarza de Granadilla	Caceres
Cebreros	Avila		Alcala de los Gazules	Cadiz
La Adrada	Avila		Arcos de la Frontera	Cadiz
La Horcajada	Avila		Grazalema	Cadiz
Madrigal de las Altas Torres	Avila		Jerez de la Frontera	Cadiz
Muñogrande	Avila		Jimena de la Frontera	Cadiz
Nava de Arevalo	Avila		Medina Sidonia	Cadiz
Sotalvo	Avila		Olvera	Cadiz
Alburquerque	Badajoz		San Roque	Cadiz
Azuaga	Badajoz		Sanlucar	Cadiz
Badajoz	Badajoz		Tarifa	Cadiz
Benquerencia de la Serena	Badajoz		Vejer de la Frontera	Cadiz
Castilblanco	Badajoz		Agudo	Ciudad Real

Municipality	**Province**		**Municipality**	**Province**
Alhambra	Ciudad Real		Turon	Granada
Almodovar del Campo	Ciudad Real		Velez Benaudalla	Granada
Calzada de Calatrava	Ciudad Real		Alustante	Guadalajara
Daimiel	Ciudad Real		Brihuega	Guadalajara
Piedrabuena	Ciudad Real		Cantalojas	Guadalajara
Retuerta del Bullaque	Ciudad Real		Chiloeches	Guadalajara
Socuellamos	Ciudad Real		Corduente	Guadalajara
Villamanrique	Ciudad Real		Fuentelencina	Guadalajara
Aguilar de la Frontera	Cordoba		Hita	Guadalajara
Carcabuey	Cordoba		Illana	Guadalajara
Cordoba	Cordoba		Miedes de Atienza	Guadalajara
Hinojosa del Duque	Cordoba		Peralejos de las Truchas	Guadalajara
Hornachuelos	Cordoba		Sacedon	Guadalajara
Montoro	Cordoba		Sigüenza	Guadalajara
Posadas	Cordoba		Torija	Guadalajara
Pozoblanco	Cordoba		Uceda	Guadalajara
Carballo	Coruña		Almonaster la Real	Huelva
Cayon	Coruña		Almonte	Huelva
Cesuras	Coruña		Aroche	Huelva
Monfero	Coruña		Ayamonte	Huelva
Ortigueira	Coruña		Calañas	Huelva
Santa Comba	Coruña		Cartaya	Huelva
Toques	Coruña		El Cerro de Andevalo	Huelva
Tordoia	Coruña		Gibraleon	Huelva
Valdoviño	Coruña		Huelva	Huelva
Almodovar del Pinar	Cuenca		Lepe	Huelva
Carrascosa	Cuenca		Niebla	Huelva
Cervera del Llano	Cuenca		Puebla de Guzman	Huelva
Cuenca	Cuenca		Villablanca	Huelva
Huete	Cuenca		Villanueva de los Castillejos	Huelva
Mira	Cuenca		Zufre	Huelva
Moya	Cuenca		Alcaudete	Jaen
San Clemente	Cuenca		Andujar	Jaen
Valdemoro-Sierra	Cuenca		Hornos	Jaen
Villagarcia del Llano	Cuenca		Huelma	Jaen
Villamayor de Santiago	Cuenca		Ibros	Jaen
Baza	Granada		Jaen	Jaen
Galera	Granada		Pozo Alcon	Jaen
Guadix	Granada		Santisteban del Puerto	Jaen
Guejar Sierra	Granada		Segura de la Sierra	Jaen
Iznalloz	Granada		Ubeda	Jaen
Loja	Granada		Villarrodrigo	Jaen
Padul	Granada		Alfaro	La Rioja
Pinos del Valle	Granada		Anguiano	La Rioja

Municipality	Province		Municipality	Province
Bañares	La Rioja		Burgo (El)	Malaga
Cenicero	La Rioja		Campillos	Malaga
Cornago	La Rioja		Cañete la Real	Malaga
Fonzaleche	La Rioja		Cártama	Malaga
Santa Engracia	La Rioja		Málaga	Malaga
Villavelayo	La Rioja		Mijas	Malaga
Villoslada de Cameros	La Rioja		Teba	Malaga
Boca de Huergano	Leon		Blanca	Murcia
Chozas de Abajo	Leon		Caravaca de la Cruz	Murcia
Gradefes	Leon		Cartagena	Murcia
Luyego	Leon		Jumilla	Murcia
Noceda	Leon		Librilla	Murcia
Oencia	Leon		Lorca	Murcia
Riello	Leon		Moratalla	Murcia
Sahagun	Leon		Mula	Murcia
Valdelugueros	Leon		Murcia I	Murcia
Valderas	Leon		Murcia II	Murcia
Villablino	Leon		Yecla	Murcia
A Fonsagrada	Lugo		A Gudiña	Orense
Abadin	Lugo		A Mezquita	Orense
Begonte	Lugo		Amoeiro	Orense
Castroverde	Lugo		Avion	Orense
Cervantes	Lugo		Baños de Molgas	Orense
Chantada	Lugo		Carballeda	Orense
Quiroga	Lugo		Cualedro	Orense
Sarria	Lugo		Lobios	Orense
Viveiro	Lugo		Maceda	Orense
Alcala de Henares	Madrid		Rios	Orense
Brea de Tajo	Madrid		Viana do Bolo	Orense
Cenicientos	Madrid		Vilardevos	Orense
Chinchon	Madrid		Xunqueira de Ambia	Orense
Colmenar de Oreja	Madrid		Aguilar de Campoo	Palencia
Estremera	Madrid		Antigüedad	Palencia
Guadalix	Madrid		Arenillas	Palencia
Lozoya	Madrid		Cervera de Pisuerga	Palencia
Navalcarnero	Madrid		Corvio	Palencia
Pedrezuela	Madrid		Dueñas	Palencia
Puebla de la Sierra	Madrid		Herrera de Pisuerga	Palencia
Robledo de Chavela	Madrid		Osorno la Mayor	Palencia
Valdemorillo	Madrid		Paredes de Nava	Palencia
Valdilecha	Madrid		Velilla del Rio Carrion	Palencia
Villarejo de Salvanes	Madrid		Villarrabe	Palencia
Alora	Malaga		A Cañiza	Pontevedra
Archidona	Malaga		A Estrada	Pontevedra

Municipality	Province		Municipality	Province
A Franqueira	Pontevedra		Armaño	Cantabria
Basadre	Pontevedra		Baro	Cantabria
San Estevo de Basadre	Pontevedra		Cabañes	Cantabria
Abades	Pontevedra		Camargo	Cantabria
Abalo	Pontevedra		Campoo de Suso	Cantabria
Amorin	Pontevedra		Cieza	Cantabria
Angoares	Pontevedra		Comillas	Cantabria
Arcade	Pontevedra		Cueto	Cantabria
Fornelos	Pontevedra		Fresno	Cantabria
Lalin	Pontevedra		Isla	Cantabria
Marin	Pontevedra		Liendo	Cantabria
O Rosal	Pontevedra		Molledo	Cantabria
Vigo	Pontevedra		Noja	Cantabria
Alaraz	Salamanca		Peñacastillo	Cantabria
Alberqueria	Salamanca		Potes	Cantabria
Alconada	Salamanca		Prases	Cantabria
Aldeanueva de Figueroa	Salamanca		Puente Viesgo	Cantabria
Aldeaseca	Salamanca		Riaño	Cantabria
Aldeaseca de Alba	Salamanca		San Vicente	Cantabria
Bejar	Salamanca		Cantabria	Cantabria
Calvarrasa de Abajo	Salamanca		Santillana del Mar	Cantabria
Cantalpino	Salamanca		Santiurde	Cantabria
Carbajosa de la Sagrada	Salamanca		Toranzo	Cantabria
El Cabaco	Salamanca		Torrelavega	Cantabria
Fuenteguinaldo	Salamanca		Villegar	Cantabria
Hinojosa de Duero	Salamanca		Aguilafuente	Segovia
Horcajo Medianero	Salamanca		Ayllon	Segovia
Ledesma	Salamanca		Cuellar	Segovia
Peñaranda de Bracamonte	Salamanca		El Espinar	Segovia
Salamanca	Salamanca		Gallegos	Segovia
San Pedro de Rozados	Salamanca		Montejo de la Vega de la Serrezuela	Segovia
Sancti Spiritus	Salamanca		Pradenilla	Segovia
Santa Marta de Tormes	Salamanca		Santa Maria la Real de Nieva	Segovia
Santiago de la Puebla	Salamanca		Sepulveda	Segovia
Terradillos	Salamanca		Aznalcollar	Sevilla
Topas	Salamanca		Carmona	Sevilla
Villamayor	Salamanca		Ecija	Sevilla
Villares de la Reina	Salamanca		Guadalcanal	Sevilla
Villarino de los Aires	Salamanca		La Roda de Andalucia	Sevilla
Abiada	Cantabria		Lebrija	Sevilla
Ambrosera	Cantabria		Lora del Rio	Sevilla
Aniezo	Cantabria		Moron de la Frontera	Sevilla
Arce	Cantabria		Agreda	Soria
Areas de Iguña	Cantabria		Arcos de Jalon	Soria

Municipality	Province		Municipality	Province
Berlanga de Duero	Soria		Villalba de los Alcores	Valladolid
Deza	Soria		Ayoo de Vidriales	Zamora
Quintana Redonda	Soria		Bermillo de Sayago	Zamora
San Esteban de Gormaz	Soria		Figueruela de Arriba	Zamora
San Pedro Manrique	Soria		Fonfria	Zamora
Vinuesa	Soria		Porto	Zamora
Los Yebenes	Toledo		Tabara	Zamora
Malpica de Toledo	Toledo		Toro	Zamora
Menasalbas	Toledo		Villalpando	Zamora
Nambroca	Toledo		Zamora	Zamora
Ocaña	Toledo			
Oropesa	Toledo			
Santa Cruz del Retamar	Toledo			
Sevilleja de la Jara	Toledo			
Villacañas	Toledo			
Villanueva de Alcardete	Toledo			
Alaejos	Valladolid			
Aldeamayor de San Martín	Valladolid			
Boecillo	Valladolid			
Castroponce	Valladolid			
Castroponce	Valladolid			
Ceinos	Valladolid			
Cogeces de Iscar	Valladolid			
Cogeces del Monte	Valladolid			
Curiel	Valladolid			
Dueñas de Medina	Valladolid			
El Campo	Valladolid			
Foncastin	Valladolid			
Fontioyuelo	Valladolid			
Fresno el Viejo	Valladolid			
Fuensaldaña	Valladolid			
Golosa	Valladolid			
Herrin de Campos	Valladolid			
Iscar	Valladolid			
La Seca	Valladolid			
La Union de Campos	Valladolid			
Mayorga	Valladolid			
Medina del Campo	Valladolid			
Olmedo	Valladolid			
San Martin de Valveni	Valladolid			
Simancas	Valladolid			
Tiedra	Valladolid			
Tordesillas	Valladolid			
Villafrechos	Valladolid			